

APPENDIX 4

DOCUMENTATION FOR F/PR REVIEW OF POST HOOKING MORTALITY

APPENDIX 5. DOCUMENTATION FOR F/PR REVIEW OF POST HOOKING MORTALITY

ATTACHMENT A

Interim Guidelines for Determining Serious Injury of Sea Turtles Taken Incidentally by the Pelagic Longline Fisheries

The development of guidelines for determining serious and non-serious injuries is essential because NMFS is mandated to reduce the levels of mortality and serious injury as mandated by the Endangered Species Act. The pelagic longline fisheries, targeting swordfish and tuna, have interactions with leatherback and loggerhead sea turtles. Although there is a low rate of observed mortality, there is a high likelihood of serious injuries.

Leatherback turtles seldom consume baited hooks, but often become entangled in the gangions. Fishermen usually attempt to remove all entangled gear, but the large size and robust nature of the leatherback often make this dangerous and difficult to do. Loggerhead turtles, on the other hand, usually consume the baited hooks and are either hooked in the mouth or throat and are usually cut free with some monofilament leader attached.

Criteria for determining serious and non-serious injuries of marine mammals have been developed (Angliss and Demaster, 1998). However, the criteria for marine mammals and sea turtles are undoubtedly different and need to be developed. Sea turtles, unlike marine mammals, are apparently able to sustain considerable injuries and still survive. Loggerhead turtles are able to keep feeding with multiple hooks imbedded in their mouths (Argano et al, 1992) and are even able to expel swallowed hooks (Aguilar et al., 1995). Loggerheads commonly survive severed limbs (Gramentz, 1989).

The injuries commonly observed and recorded by NMFS observers will be categorized as non-serious, serious, and serious with associated mortality.

I. Non-serious injuries:

1. Entanglement of monofilament line (mainlines, gangion line, or float line) where there are no visible injuries (cuts and/or bleeding) and gear is completely removed.

II. Serious injuries meet any the following life threatening criteria:

1. Entanglement of monofilament line (mainline, gangion line, or float line) could directly interfere with feeding
2. Entanglement of monofilament line (mainline, gangion line, or float line) could interfere with mobility
3. Entanglement of monofilament line (mainline, gangion line, or float line) resulting in substantial wounds (cuts, constriction, bleeding) on any body part.
4. An animal ingests hooks in beak or mouth (visible) could interfere with feeding.
5. An animal is hooked externally in neck or flippers resulting in wound.

III. Serious injuries (with associated mortality) are those animals that:

1. Animal is hooked inside throat/esophagus hooked (28.9%) (Aguilar et al., 1995)
2. Are beak/mouth hooked with substantial line attached (>3 feet loggerheads and >6 feet leatherbacks) (unknown mortality rate).

The following are commonly observed injuries and suggested injury classification:
NS= non-serious injury, SI= serious injury, SM= serious injury with associated mortality.
unknown mortality rate)

Leatherback turtles:

Entangled (cut free)	NS
Entangled (line trailing >6 feet)	SI
Hooked Externally (line trailing >6 feet) SI	
Hooked Mouth (line trailing <6 feet)	SI
Hooked Mouth (line trailing >6 feet)	SM*

Loggerhead (hard-shelled) turtles:

Entangled (cut free)	NS
Hooked Externally (fine trailing)	SI
Hooked Externally (cut free)	SI
Hooked Externally (hook removed)	SI
Hooked Beak/mouth (line trailing <3 feet)	SI
Hooked Beak/mouth (fine trailing >3 feet)	SM*
Hooked Beak/mouth (cut free)	SI
Hooked Beak/mouth (hook removed)	SI
Hooked Throat/esophagus (line trailing)	SM*
Hooked Throat/esophagus (cut free)	SM (28.9%)
Hooked Throat/esophagus (hook removed)	SM (28.9%)

ATTACHMENT A

References

- Aguilar, R., J. Mas, and X. Pastor. 1995. Impact of Spanish swordfish longline fisheries on the loggerhead sea turtle *caretta caretta* population in the western Mediterranean. NOAA-NMFS-SEFSC-Technical Memorandum 361:1-6.
- Angliss, R.P. and D. P. DeMaster. 1998. Differentiating serious and non-serious injury of marine mammals taken incidental to commercial fishing operations-. Report of the serious injury workshop 1-2 April 1997, Silver Spring, Maryland. NOAA Technical Memorandum NMFS- OPR- 1 3, 48 p.
- Argano, R., R. Basso, M. Cocco, and G. Gerosa. 1992. Novi dati spostamenti di tartaruga marina comune (*Caretta caretta*) in Mediterraneo. Bollettino Musel Istituti Universita. Genova 56- 57:137-163.
- Gramentz, D. 1989. Marine turtles in the Central Mediterranean Sea. Centro 1:41-56.

ATTACHMENT B

Developing Interim Guidelines for Determining Serious Injury of Sea Turtles Taken Incidentally by the Pelagic Longline Fisheries

Sea turtles are listed as either endangered or threatened under the U.S. Endangered Species Act (ESA). The National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS) share jurisdiction for sea turtles under the ESA. Section 7 of the ESA requires federal agencies to consult with either NMFS or USFWS when their actions are likely to affect listed sea turtles. In the case of domestic pelagic longline fisheries managed under a federal Fishery Management Plan, the NMFS Office of Sustainable Fisheries must consult with the NMFS Office of Protected Resources relative to the effects of the fishery on sea turtles. Sea turtles are incidentally taken as bycatch in federally-managed pelagic longline fisheries. Observers accompany a small percentage of pelagic longline trips and record data on sea turtle bycatch, among other things. Since mid-1999 observers have used the attached observer reporting form to record the condition of bycaught turtles. Table I provides an example of the comments recorded by observers on board pelagic longline vessels. NMFS analyzes observer data to estimate the total lethal and non-lethal take of sea turtles in the fishery. These estimates are critical to understanding the population-level effects of this bycatch and the estimates are used to monitor sea turtle bycatch relative to take levels authorized in the Incidental Take Statement of the Section 7 Biological Opinion, under the ESA. While there is a low rate of observed mortality (i.e., turtles dead when the longline is hauled in), there is a high likelihood of serious injuries which may or may not eventually result in the death of the animal.

NMFS defined "Serious Injury" for marine mammals as *"any injury that will likely result in mortality"* and defined "Injury" as *"a wound or other physical harm. Signs of injury to a marine mammal include, but are not limited to, visible blood flow, loss of or damage to an appendage or jaw, inability to use one or more appendages, asymmetry in the shape of the body or body position, laceration, puncture or rupture of eyeball, listless appearance or inability to defend itself, inability to swim or dive upon release from fishing gear, or signs of equilibrium imbalance. Any animal that ingest fishing, gear, or any animal that is released with fishing gear entangling, trailing or perforating any part of the body will be considered injured regardless of the absence of any wound or other evidence of an injury."* (50CFR §229.2). Requirements of the Marine Mammal Protection Act (MMPA) resulted in the convening of a workshop to differentiate between serious and non-serious injuries of marine mammals (Angliss and Demaster, 1998 - enclosed). The definition of "injury" for marine mammals and sea turtles are not likely to be identical and, thus, NMFS recognizes the need to review its current methodologies and to develop sea turtle specific definitions and criteria to determine which interactions between sea turtles and pelagic longline gear are likely to result in injuries leading to mortality (serious injuries) and which are not.

The result of sea turtle interactions with pelagic longline gear include entanglement and/or hooking (external or internal). The at-sea "treatment" that a captured turtle receives is variable and depends on conditions including, but not necessarily limited to, federal regulatory requirements, turtle size and species, the presence of an observer, the

sea/weather conditions, experience and motivation of the captain and crew, and nature of the interaction. A general description of the Atlantic pelagic longline fishery and a report of gear, environment and fishing practice parameters which may influence sea turtle interactions are enclosed for your information.

For discussion and review purposes the following categories are proposed:

I. Non-serious injuries:

1. Entanglement in monofilament line (mainlines, gangion line, or float line) where there are no visible injuries (cuts and/or bleeding), the gear is completely removed, and the turtle swims strongly away from the vessel.

II. Serious injuries that may or may not result in mortality when turtles are released alive after the interaction:

- I. Entanglement in monofilament line (mainline, gangion line, or float line) that directly or indirectly interferes with mobility such that feeding, breeding or migrations are impaired.
2. Entanglement of monofilament line (mainline, gangion line, or float line) resulting in substantial wound(s) (cuts, constriction, bleeding) on any body part.
3. Hooking external to the mouth resulting in substantial wound(s) (cuts, constriction, bleeding) with or without associated external entanglement and/or trailing attached line.
4. Ingestion of hook in beak or mouth (visible), with or without associated external entanglement and/or trailing attached line.
5. Ingestion of hook in the mouth, throat area, esophagus or deeper with or without associated external entanglement. and/or trailing attached line.

NMFS is seeking comments and input on the effects of these types of interactions on the health and viability of turtles involved in such interactions. Recommendations on apportioning mortality based on detail-specific criteria are sought.

ATTACHMENT C

John Hoey- Comments on SEC initial draft criteria

Draft criteria for determining serious injury and/or mortality for sea turtle pelagic longline interactions (October 10, 2000 e-mail draft from Wayne Witzell).

This initial draft reflects the decision rules that were used in the June 20, 2000 biological opinion, i.e. that almost all sea turtle - longline interactions cause serious injuries. While only a few were coded as serious injury with associated mortality I think that there are additional non serious injury conditions that are reasonable and would help encourage careful handling. Given the limited post-release data available the assumption that "there is a high likelihood of serious injuries" seems questionable. Given the text references in the third paragraph to turtle hardiness and resilience, the phrase "high likelihood" should be replaced by "varying levels of risk depending on the species and type of interaction". This would seem to be more in line with NMFS Technical Memo - SEFSC-222 which appeared to emphasize internal wounds.

Despite reference in paragraph 3 to the serious injury workshop on marine mammals and the undoubtedly different" criteria for serious injury for sea turtles, the categorizations presented at the bottom of page 1 reflect discussions on marine mammal injuries and interactions primarily with gillnet gear and pot warps from lobster gear. As I mentioned at the serious injury workshop and in more recent discussions and written comments, there are very important gear differences between gillnets and lobster pot warps that must be acknowledged.

In the marine mammal serious injury discussions, the interaction types that are listed under item II - ie. Serious Injury with respect to entanglements that interfere with feeding, mobility and cause substantial wounds - referred specifically to heavy multi-filament nylon lines in single strands and multiple strands that wrapped around appendages with the resulting drag and friction cutting through soft tissue and bone. The diameter, number of strands, weight in water, and drag associated with these gears is very different than those same characteristics and others associated with the types of monofilament lines used in the U.S. pelagic longline fishery.

The monofilament used by the longline fleet is designed to have negligible resistance and drag and extremely low weight despite having great strength. In 1998 and 1999 gangion pound tests were usually > 300 lb. test (only one set with 250 lb. test), whereas mainline pound tests were usually -e- 600 lb. test. These characteristics must be factored into the serious injury criteria along with the fact that very few longline observer comments (based on my partial examination of Atlantic interaction forms) note cutting or tearing, wounds on appendages, whereas this is frequently noted for marine mammal interactions with gillnets and lobster warps. I think it is critically important to draw a distinction between the different weights, pound tests, for the monofilament line that is associated with turtle interactions. George Balazs included information on monofilament strangulation for Hawaiian Green turtles on page 130 of the Honolulu lab program review 2000 document. The illustrated entanglement was attributed to recreational shoreline fishing with 6-lb. test monofilament. I believe there have been similar observations

associated with jetty fishing in the Gulf of Mexico and Atlantic. It should be part of the standard sampling protocol for monofilament samples to be taken for all stranded or nesting turtles that have attached gear.

As I mentioned at the serious injury workshop and in discussions with SEFSC and PR turtle scientists, monofilament line has memory (stretch) characteristics, especially for the pound test used for mainlines (usually > 600 lb. test) and gangions (usually > 300 lb. test), that make it very difficult to knot or twist and tangle strands so that the knot or tangle will hold once tension is eliminated from the line. Because of these characteristics fishermen rely on crimps to connect sections of line, especially the heavier mainline. In those cases where entangled turtles are released with trailing loops of monofilament that do not include an attached hook that is impeded in an appendage or shell, it would be very likely that the gear will simply fall off once line tension is released.

In those cases where an external hooking has occurred or where the hook is in the beak, jaw, or tongue (externally visible) and the turtle is released with limited line attached, the size of the turtle and length of attached line should be considered. There are no reports that I am aware of that specifically identify a line length threshold of 1 meter for loggerheads and 2 meters for leatherbacks, nor is rationale provided in the draft for these arbitrary length thresholds. These lengths may be reasonable targets now that the fleet is required to carry line cutters, but this hasn't been the case in the recent past and it should be discussed with observers who have experience with conditions aboard vessels especially freeboard height and hauling practices. Since the 1995 Hawaii workshop emphasis has been placed on not pulling or putting tension or pressure on the line that is entangling the turtle. Fishermen therefore chose to leave slightly more line on the turtle when freeboard was high or weather conditions limited the Captains ability to maneuver because they thought that was better for the turtle than dragging the turtle closer to the boat. This would be particularly true for leatherbacks especially when they were active. A 5 meter threshold for leatherbacks would reflect reasonable handling distances aboard US commercial vessels where an attempt to avoid straining the line and dragging the turtle is probably being made. Five meters of monofilament would probably weigh less than a pound or two in the water which would seem to be a negligible drag, on a several hundred pound leatherback. Some of this concern about a line length threshold relates to post-classification (after the fact) when NMFS has not provided clear guidance to the fishermen. The same can be said for classifying all turtles as hooked by ingestion including those clearly noted as hooked in the mouth when the observer guidance described in Technical Memo SWFSC - 222 indicated that hooks were considered ingested if the hook was "past the mouth cavity and in the esophagus".

If all turtles that are released **are all categorized similarly as seriously injured** whether they are trailing small lengths of monofilament (< 1 or 2 meters as drafted) after being either externally hooked or hooked in the jaw (hook left in), released with only the hook in the jaw (no trailing gear), and hooked turtles that are completely disentangled with the hook removed, **these criteria will undermine efforts to encourage careful handling and extra effort to maximize survival.** I can't see how this risk averse decision would be consistent with previous agency actions relative to other fisheries, handling, or resuscitation guidelines, and the limited post-release data that is available.

Post-release mortality studies include Aguilar's study of survival of **deeply hooked turtles** from the Spanish Mediterranean fishery which uses very small hooks and baits and provides the 28.9% mortality rate listed on page 2 of the draft. Information from tracking studies from the Hawaiian longline fishery **need to be reviewed**. In the Honolulu lab program review 2000 document (page 130) it is noted that satellite transmitters have been deployed on 38 loggerheads, 11 olive ridleys, and 3 green turtles (a total of 52). "Twenty seven of the deployments have resulted in pelagic trackings ranging from 0.2 to 8.2 months duration covering distances of 13 - 7,282 km. The remaining 13 deployments have produced no tracking data, and all of these involved turtles that were classified as "deeply hooked" (hook lodged in the esophagus and impossible to remove)." This last sentence seems to be an incomplete thought and the total of 27 and 13 is 40, so an obvious question remains about the remaining 12 tracks. The next two sentences in the program review are as follows: "Of the 39 tracked turtles, 22 were deeply hooked and 17 "lightly hooked" (the hook was in the jaw or elsewhere externally allowing easy removal). There were no significant differences between these two groups for the duration of transmissions in months or the distance the turtles traveled." Additional information on these tracking results are critically important. If all 13 of the turtle deployments that produced no tracks were deep hooked what other condition notes were recorded and are these included in the total of 22 listed as deeply hooked or in addition to the 22? What was the species breakdown for the lightly and deeply hooked turtles and for the no track turtles?

If the 13 no tracks are in addition to the 22 deeply hooked then we have 39 tracked turtles and 13 no track turtles (total 52) with 35 deeply hooked and 17 lightly hooked. If the 13 no tracks only reflect short-term mortality as opposed to transmitter or battery failure or another co-variate, then 37% of the deeply hooked turtles may have died. The obvious questions include what the additional condition notes might include and whether the no track deployments all share a common characteristic (same trip, same month, similar area, similar size and species, transmitter lot, battery lot, etc.). In any case given the number of observations in both the Anguilar and Balazs studies it would seem that this data could justify assigning a mortality rate between 30% and 40% for deeply hooked turtles. I would assume given similar tracking distances and speeds a much lower mortality rate (some might argue a negligible rate) would be justified for lightly hooked turtles. Those turtles that are completely disentangled should not be categorized as injured unless wounds or trauma are evident.

In light of the preceding I would offer the following alternative categorizations of interaction types:

1. **Not Injured** - Turtles that spit hooks and baits while the gear is being retrieved and entangled turtles where hooks are not involved and where the turtle is released with no gear attached.
2. **Non-serious Injury (lightly hooked)**. - Disentangled externally hooked turtles (not in jaw, beak or tongue) released with limited¹ gear attached. Also include turtles hooked in the jaw, beak, or tongue (externally visible) if the hook was removed for those sizes of turtles that could be brought aboard with dipnets and there was no other tissue damage or bleeding noted. Externally hooked (not in jaw,

beak, tongue, or neck - only carapace, flippers or tail) large turtles released trailing gear longer than the limited¹ gear thresholds but less than 5 meters in length.

3. **Serious injury - level 1 (deeply hooked but limited gear).** - Hook lodged in the esophagus and impossible to remove with the turtle released with limited¹ gear attached and observer notes indicating active and reasonable condition. Externally hooked turtles released with limited¹ gear attached and with non-critical tissue damage or limited bleeding noted, including turtles hooked in the jaw, beak, or tongue (externally visible). Different mortality ranges should be provided for these two groupings.

4. **Serious Injury - level 2 (deeply hooked with excessive gear).** -Hook lodged in the esophagus and impossible to remove with the Turtle released with more than the limited¹ gear attached and/or wounds noted to the eyes or neck. If an attached buoy was left trailing that would be a serious injury level 2 along with any turtles where the observer notes reference struggling or weak condition or a visible serious wound more extensive than a hook puncture.

Assigning rough quantitative ranges for mortality rates to the preceding categories will require a thorough review of the condition notes associated with the Honolulu tracking studies and any other information that has been developed over the last few years. This should be a topic for more extensive discussions including a range of people with greater experience than I have on events at-sea as well as vets and other biologists. It would seem reasonable however for the mortality rates for serious injury - level I deeply hooked turtles and serious injury - level 2 deeply hooked turtles to be different and preliminary range estimates might be reasonably established once the tracking study results are more thoroughly reviewed. I would also obviously have a 5th category for dead turtles.

¹Refers to line distances of <1 meter for loggerheads and <2 meters for leatherbacks.

COMMENTS FROM ELLIOT JACOBSEN

Developing Interim Guidelines for Determining Serious Injury of Sea Turtles Taken Incidentally by the Pelagic Longline Fisheries

Comments

1. It is clear from the Final Report 50EANA7QO063, that not only do the terms "injury, non-injury, and serious injury" need to be defined, but that the observations and nomenclature to describe the observations must be standardized. Here are some recommendations:

a. **Serious Injury**: having a negative effect on turtle survivorship or negative effect on the animal's contribution to the population.

b. Definition of **injury** for marine mammal and sea turtle should be the same. The causes may be different. Injury: damage inflicted to the body by an external force (from Doriand's Illustrated Medical Dictionary).

c. While by process of elimination, a **non-serious injury** would be an injury that is not defined as a serious injury, still this needs definition.

d. A definition of "**foul-hooking**" needs to be included in any document.

2. Major problem is that we can't determine the extent of injury without establishing criteria for a healthy marine turtle. A group has been formed at the University of Florida to establish the "gold standard" for sea turtle health assessment. This will take several years to define. So when an attempt is made to try and categorize or establish criteria for injury, both serious and non-serious, realize that we are limited in our ability to stringently categorize animals. Clearly an animal that is moribund and appears to be near death because of obvious massive injury is easy to categorize. The difficulty is with those animals that appear to have minimal external damage but may have significant internal damage or are septic as a result of the injury. As all of us in medicine know, trying to get a handle on these cases is extremely challenging. So everyone needs to know what the limitations are. To come up with a more meaningful way of categorizing these animals, ultimately turtles with certain types of injuries need to be followed through time using satellite monitoring. This will be the only way to get a scientifically based handle on, outcome of injured animals. Categories of injuries can be established and criteria then developed to allow some type of categorization. Hopefully this will be an outcome of your proposed meeting.

3. We believe that any animal that is released with an intact attached hook, is at risk, especially if line is still attached. The more line, the more risk of being snagged underwater and drowning. The level of risk of drowning is dependent on the size and robustness of the turtle, as well as the area hooked. Of the 30 stranded turtles evaluated in a study done by us, at least 10% had evidence of fishing line injury severe enough to explain the cause of death. One had swallowed line, resulting in imbrication of the intestinal tract. One had a hook lodged in the larynx, associated with necrotizing laryngitis. One had an abscess ventral to the tongue, which could have resulted from a

fish look lodging there. I think the abscess impacted on the turtle's ability and desire to eat. It should be assumed that if a turtle is entangled, that a hook could be internalized. The only way to dismiss this would be to radiograph these turtles. Even if a hook was found externally, that would not preclude an internal hook. A turtle with a swallowed hook could be in grave danger.

4. Questions to be answered:

- a. How long does it take for hooks to rust out?
- b. How stable is the monofilament line relative to disintegrating in salt water?
- c. Is it possible to salvage any of the turtles for rehab, to conduct a parallel study with radiotransmitters?
- d. In the report, there was a suggestion that some turtles could be entangled multiple times in longlines. What is the likelihood of this happening?
- e. How toxic are light-sticks if they are swallowed? Are they ever swallowed?

5. There was no mention in the "Description of Longline Fishery" paper of what is used to weigh down the lines in the water. I assume that no toxic metals (for e.g., lead) are used.

FROM Edward R. Gaw, HI-LINER FISHING GEAR AND TACKLE, INC.

November 16, 2000

UNITED STATES DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
National Marine Fisheries Service
Attn: Office of Protected Resources
Room 13630,
Silver Spring, MD 20910

Dear Ms. Conant,

Thank you for the opportunity to participate in your initial solicitation of input concerning sea turtle- pelagic long-line interactions. HI-LINER Fishing Gear is the largest US exporter of pelagic monofilament long-line materials to the world pelagic swordfish/tuna long-line fleets. We maintain several offices in many coastal nations to provide local inventory, product support and technical expertise. Currently, we remain the key supplier to a majority of pelagic long-line vessels fishing from Spain, Portugal, South Africa, Brazil, Uruguay, Mexico, Chile, Australia - to name a few. It is the purpose of this letter to establish the position and standing of -HI-LINER among the world-wide pelagic long-line fleets, principally those plying the North/South Atlantic oceans,

HI-LINER has maintained a long history of product introduction, development and extension. The evolution of this style of fishing equipment has not been limited to the US. Acceptance of this material by other more traditional fishing nations has produced advancements and improvements in both equipment and technique. HI-LINER's emphasis on the operational success of individual international fishing vessels has left us uniquely qualified to comment on long-line gear principles, dynamics and continued product evolution.

However, your solicitation specifically requested input concerning injuries and their relative short/long term implications. It remains my strong belief that our subjective contribution to this phase of your investigation would contribute little to the attainment of the true goal of your discussions, Minimization/Avoidance of Sea Turtle//Pelagic Long-line Harmful Interactions. I would formally request that HI-LINER be consulted directly prior to any discussion of gear modifications, operational gear parameters and dynamics relative to sea turtle interactions. Combinations of traditional foreign fishing techniques with modern monofilament pelagic long-line gear has proved the flexibility and malleability of this style of fishing.

At your convenience, your review would be greatly appreciated. Please advise your requirements. Thank you for your time and considerations.

Regards,

Edward R. Gaw
HI-LINER FISHING GEAR, Inc.

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Dr. Donald R Knowles
Director
Office of Protected Species
NOAA/ NWS
Silver Spring, MD 20910

Dear Dr. Knowles,

I have received the packet of information on the concerned interactions between sea turtles and longline fishing gear. The following comments are my initial reactions to the materials sent in the packet as well as my general sense of the importance of this particular conservation issue. Other than the information you sent, I do not have a good knowledge of this particularly fishery.

Observations:

1. Generally speaking, sea turtles are robust animals and can recover eventually from superficial external injuries such as would occur from a hook that is removed.
2. Physiologically, it is my impression that the leatherbacks are not as resilient hardy as the hard shelled turtles. This is suggested because of softer epidermal tissue, softer heads and beaks, heavier body mass and generally softer bodied food sources. Thus such actions as hooking, lifting from the water, and ingestion of hooks and lines may have more damaging and long lasting impacts on an individual leatherback.
3. Ingestion of a hook and line (depending on size) is likely to have long term impact on survivability of any sea turtle. We see lots of "floaters" in South Carolina. These turtles generally have a peritoneal infection which is causing gas to accumulate in the body cavity. Eventually these animals weaken and die unless treated. While I do not know this for a fact, hooks could be an initial cause of this problem. My concern is that ingested hooks may provide a long term irritant and source of bacterial entry. In addition, if the hook lodges in heart or lung tissue, or results in occlusion of the gut, the turtle may die directly for the event.
4. Leaving several yards of monofilament line hanging from the mouth is another source of potential problem. The line can be fouled and cause drag, swallowed causing an occlusion of the gut or wrapped around a flipper or caught on another object. Feeding

will be impaired to some degree depending on several variables.

Recommendations:

1. A physiological study of naturally hooked animals could address some of these concerns. Variables to be evaluated are movement of hooks once the line is cut, impact on feeding ability, changes in stress hormone and reproductive hormone levels and susceptibility to local or internal infections. In an aquarium, under proper medical supervision animals could safely studied. If and when they appeared to be suffering or taking a serious turn for the worse, surgical and antibiotic treatment could be applied to insure survival and eventual release.
2. Several veterinarians have experience in removing hooks. Their observations and results could be instructive in this regard.
3. Whenever possible, the entire line and any portion of the hook which can be seen should be cut out prior to release of the animal.
4. Additional observer work would seem to be important in zones 5, 6 and 7 and possibly 2.

I believe this fishery interaction is a serious problem for sea turtles.

Sincerely,

David Wm. Owens
Professor and Director
Graduate Program in Marine Biology

FROM MOLLY LUTCAVAGE, PHD, SENIOR SCIENTIST, NEW ENGLAND
AQUARIUM

Donald R. Knowles
Director, Protected Species
National Marine Fisheries Service
Silver Spring, MD 20910

24 November, 2000

Dear Dr. Knowles,

Thank you for the opportunity to submit comments on the materials that your office forwarded re. effects of interactions between longline fishing gear and sea turtles.

NMFS is doing the right thing by developing criteria describing long line gear interactions that are specific to sea turtles. Although marine mammals and sea turtles share the distinction of being air-breathing vertebrates, they have very different behaviors and susceptibilities or responses to human interactions. Since we don't have all of the answers regarding gear interactions and sea turtles, it will be productive to have a suite of descriptions that accurately characterizes a sea turtle's condition, and disposition of gear left on the animal. Only then will all parties have the necessary information to proceed with mitigation that will limit or eliminate harmful interactions, and reduce burdens for fishermen if and when it is appropriate to do so. Specific comments follow below:

I. " Non-serious injuries" This category is contradictory and misleading. A "non-serious injuries" cannot be equal to "no visible injuries". If the animal is not injured, the observation should clearly state it as such.

1. Suggested alternatives to non-serious injuries that would describe animals that have run into gear but that have no visible injuries and are not suspected to have had them:
Gear Interaction 1, resolved (trailing or entangling gear has been removed)
Gear Interaction 2, gear not completely removed.

2. "Visible injury, minor (superficial)

Any visible injuries such as cuts, minor lacerations- that are not likely to jeopardize the health or impair the movements or behavior of the turtle. This type of injury would be expected to spontaneously heal/resolve.

II. Serious Injuries The five types of interactions could all be construed as serious. However, there are still some grey areas. For example, Entanglement in monofilament line. That interferes with mobility... such that feeding, breeding or migrations are impaired." Does this mean that the turtle is released with the monofilament, or that it was impossible to free it of binding gear? If yes- then of course, this is serious injury. But if the animal were freed of the mono and then showed signs of strength and normal swimming/behavior, would the designation of serious injury still hold true? [I hope that we all are working to making this situation go away. If still alive, all badly entangled

animals need to be freed of gear. I need to know/understand whether there are cases where a longliner crew would be unable to free the turtle? If the turtle is attached via float line to rest of gear, doesn't the boat always have some line to the animal that can be retrieved?]

Regarding 4. Ingestion of hook in beak or mouth... does this mean that the observer can see the hook? There are cases where sea turtles have hooks in the keratinized tomium, but because it's not in the soft tissue, there may be little or no impairment, and the hooks eventually get dislodged. This is different than cases where the hook is in the soft tissue, where it is likely to be pushed further into the tissue.

Possible alternatives could be

Gear Interaction- Hooking

1. Visible, external, no obvious injury [no mortality expected]
2. Visible, external, injured [injuries serious, mortality could result]
3. Internal/Gut hooked; serious injury suspected or likely. [mortality could result]

From Table 1 1999 NOAA Fisheries Sea Sampling Program observers can obviously provide descriptive information that can be used to make an assessment of a turtle's status, especially in regard to serious vs. non serious injury, and whether a turtle is injured at all. There's plenty of room for improvement. For example, "hooked in mouth"- does this mean in the tomium, or in the soft tissue? Another one "swam off readily, although seem tired." My impression is that with explicit training, observers could provide unambiguous information. Photographs are also useful as supporting information.

The information provided by the Hoey report was extremely helpful. His analysis provides a good place to start to examine environmental relationships between sea turtles and longline gear, and where they are most likely to converge. However, we need more details, as temperature ranges were quite broad. We had this same problem in trying to find relationships between leatherbacks and real-time ocean frontal conditions, using limited aerial survey data from right whale and other surveys. For example, depending on geographic area, leatherbacks were found in SST's ranging from 10 -23⁰ C, even though the average SST from right whale survey databases was 16⁰ C (Distribution of Leatherback Turtles in relation to the Environment, Cooperative Agreement #40GENF400929, report to NMFS SEFSC, M. Lutcavage). Most of our observations came from inshore surveys, and are not particularly helpful in identifying offshore habits. I understand that the NMFS SEFSC recently funded a study by Morreale to examine SST's and location of longline sets that had interactions with sea turtles. It would be very helpful if these results were made available for review. It would also be important to see Scott Eckert's results of diving habits and travel patterns of leatherbacks that he's tracked with satellite transmitters in the Atlantic and elsewhere, particularly if this study were funded by NWS and if a technical report were available for distribution.

I was dismayed to see NMFS incorrectly use a report prepared by Greenpeace (submitted to the Sea Turtle conference but not subjected to peer review), in the recent Biological Opinion (Jun 30,2000). Page 35 states "Perhaps a better way of looking at the data is to apply the 29% mortality estimate provided by Aguilar (1995) to the average

annual estimated take of 715 animals (Yeung et al., *in prep*) which indicates that an average of 207 animals annually either die or are seriously injured by pelagic longlines in the U.S. fleet." There is no way of knowing whether the Yeung et al. data is convincing, because the reader is unable to see it. The Aguilar et al. paper provides useful (although very general) information on turtles taken in the Spanish longline fishery, but is extremely flawed as a scientific paper on post release mortality or survivorship. The data shown in their Table 1, which suggests that " 20-30% of sea turtles may die after having been captured by a longline" is based on turtle survivorship of animals kept in "large aquaculture pools with the aim of estimating the mortality rate of the individuals released with hooks still in their bodies ..." The authors of this study did not conduct necropsies to establish cause of death, which is an absolute requirement, nor did they conduct control experiments that would establish whether the captured turtles had a lower survivorship than animals not subject to capture but also held in the tanks. Anyone that has raised sea turtles in captivity knows that they are subject to infections, disease, and other problems that arise from culture. Without addressing all of these concerns, this study cannot be used to establish survivorship or post release mortality. It would not have passed peer review, and NWS needs to be honest about using it as "best available science" when it is clearly does not satisfy sufficient scientific standards for establishing cause of death. Similarly, the reference to Balaz unpublished data (page 60) on a "44% mortality estimate observed by Balaz (person. comm) needs to come forward for evaluation. A good scientist cannot simply accept an unsubstantiated estimate for this important issue. Without a report to evaluate, there is no credibility.

The report prepared by Augliss and DeMaster was comprehensive, accurate, and very well done. It clearly sets the agenda for sea turtle/longline interactions, and it should serve as a model and guide for discussion and process for establishing distinct sea turtle criteria. For example (page 4)" Participants stressed that a thorough necropsy is necessary to determine the cause of death of large cetaceans and the degree to which an entanglement may have contributed to the mortality... (and as a footnote.... was stressed for all marine mammals in general)." The section "Collecting data on injuries" was also extremely important and clear on what needs to be done- the same holds for sea turtles: "Workshop participants identified several actions that would improve the data that observers provide on incidental injuries, such as 1) improve the training for recording interactions with marine mammals, 2) include marine mammal scientists in the debriefing... 3) encourage observers to provide more detail ...". All of these points are relevant to sea turtle and long line interactions.

Although I've listed some comments above, I look forward to further discussion at our upcoming meeting. Thanks again for the opportunity to weigh in on this issue.

Sincerely,

Molly Lutcavage, Ph.D.
Senior Scientist, ERL

United States Department of the Interior

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November 20, 2000

FAX

TO: Therese Conant

FROM: Thierry Work

Total Pages : 3

Dear Ms. Conant

Thank you for the opportunity to review the material on long line and marine turtle mortalities. In an attempt to make this issue more tractable, consider the following simple model:

Line is set-->turtle is attracted to line-->turtle gets hooked-->turtle dies or survives

Line setting:

What factors are conducive to turtle being hooked and how could these be prevented? Contract report 50WANA700063 outlines some of these including depth of line, time of set, temperature, use of light sticks, area of set, date of set.

Attraction:

What is it exactly that attracts turtles to bait? Are there certain bait types that would be equally attractive to fish but less so to turtles? Could artificial baits be developed that are repellent to turtles but not target fish? Could sonic devices be placed around lines that repel turtles? This would call for research on olfactory and visual cues that attract turtles to bait.

Hooking:

According to the contract report, this appears to be one area where more information could be gathered.

Once an animal is hooked or entangled in the line, how severe is the injury? The NOAA-

NMFS-OPR-13 goes some way into defining that for marine mammals. Defining injury based on hook placement alone in marine reptiles may be misleading. For example, lightly hooked turtles (hook on beak only, no visible trauma) may drown from forced submergence. On the other hand, we saw turtles with traumatic amputations of the forelimb from fishing line that survive quite well. Also, some turtles considered deeply hooked and tracked by satellite have been shown to survive many months. Finally, an animal may be hooked in the flipper (survivable injury) but released with several feet of leader thus posing potentially lethal risk of the leader wrapping around limbs or neck and causing strangulation or limb amputation. Perhaps consider standardizing criteria to define an animal as uninjured, moderately or severely injured using something like the following criteria.

Uninjured-Animal vigorous, breathing is unremarkable, hook on beak only (easily removed with no visible trauma) and no evidence of external trauma from line or hook.

Moderately injured- Visible trauma from hook on beak, flipper or shell. Visible trauma from line around flipper (e.g. abrasion or cutting into flipper). Animal vigorous, breathing is unremarkable.

Severely injured- Hook in soft tissue of mouth (tongue, soft palate), or deep into esophagus. Leader wound tightly around limb with a partial avulsion or amputation. Alternatively, no visible injuries but animal weak.

Documenting: Following data would probably be helpful to standardize reporting. Items (*) are those used to decide whether animal is uninjured, moderately, or severely injured. Items(*,**) may be useful for long term prognostication.

- Hook number and type
- Date and time of set
- Water temperature
- Type of light stick used (color, make)
- Hook location*
- Photo of hook set in turtle or of line-induced injury*
- Length of turtle
- Hooked removed (Y/N)**
- Animal (vigorous, weak, dead)*
- If hook not removed, length of lead left on hook.**

Any dead animals should be stored frozen and returned to a laboratory for complete post-mortem exam. Alternatively, observer puts animal aside and performs a necropsy taking appropriate samples in formalin and frozen once catch is finished (how realistic this is depends on conditions on the boat). Perhaps NMFS needs to dedicate observers to do this task only (documenting extent of injuries and doing necropsies).

Other avenues of pursuit: Given that hooks are set in 24 hour periods, are there materials that can be used to make hooks that will have similar tensile strength as steel but will degrade or dissolve in, say 7-10 days? For example, some darts used to immobilize animals have a needle with a barb made of a material that dissolves once it contacts body fluids thus causing less injury when the dart is removed. The key would be to find a would

be to find a material that dissolve, just more slowly (>24 h) allowing desirable fish to be caught.

Turtle dies or survives.

Efforts should be made to satellite tag animals in uninjured, moderate, and severely injured category to evaluate long-term outcomes. Perhaps this could readily be done in fisheries that consistently catch large numbers of turtles. A model animal could be something not critically endangered like the loggerhead.

I hope this is of some use.

Sincerely

Thierry M. Work
Wildlife Disease Specialist

FROM JOSEPH P. FLANAGAN DVM, HOUSTON ZOOLOGICAL GARDENS

4 Dec 2000

Donald R. Knowles
Director
Office of Protected Resources

Dear Dr. Knowles,

I have been working with sea turtles for approximately 16 years through the National Marine Fisheries Service Galveston Laboratory. During that time I have seen a number of sea turtles (mostly Kemps Ridleys) which have been caught on hook and line in the recreational fisheries here on the upper Texas coast. These turtles by and large, have ingested hooks and are presented within a day of capture.

Presentation has varied with size of the turtle, type of hook (size, shape, material), presence or absence of a leader, and quantity of line present. My approach to treatment has varied with the actual location of the hooking. At presentation, the hook may be present in the oral cavity, any point in the esophagus, or in the stomach. The damage done by the hook will vary with the point in the body that is hooked, the depth of hook penetration, and the length of time the hook has been present. I am never presented with animals that have had hooks for more than a few days.

In general, with a simple hook, the deeper (farther into the esophagus or stomach) the animal is hooked, the greater the chance of damage or potential damage. important exceptions to this are animals that are hooked in the oral cavity with the point of the hook penetrating into the orbit or globe of the eye, or animals that are hooked into a major blood vessel. Hooks that penetrate through the gut wall can cause variable damage, depending on what area or which organ the hook impacts. I have observed hooks that have punctured the major vessels near the heart, resulting in nearly immediate death of the animal. The point of a hook may cause a localized infection at the point of penetration. This infection could remain quiescent, and ultimately resolve without long term harm to the animal, or could result in a generalized infection and death. It is possible that a hook without a significant length of attached line can pass through the digestive tract without harming the turtle. I cannot guess at what percentage of cases this may occur.

Hooks anywhere in the gastro-intestinal system that trail fishing line can lead to placcation of the intestines and potential peritonitis (coelomitis) with a linear foreign body. I consider any length of trailing line to be a significant risk to the health of a turtle as the line passes into the intestinal tract. Long lengths of line trailing from the oral cavity can entangle the turtles neck or appendages and result in physical harm to the animal. Loss of a flipper may reduce the animals feeding efficiency, its ability to evade predators, or impact its ability to reproduce.

Animals hooked in locations other than the gastro-intestinal system have a lower risk of adverse health effects due to the hooking incident. Hooks penetrating skin or superficial

muscle groups are likely to establish a localized infection, but are likely to slough with infected tissue. The turtle will heal albeit with a defect where it was hooked. If hooked in or near a joint, the injury will be more severe. Penetration of a joint may impact the animal's mobility and is more likely to result in systemic infection.

Hooked turtles can suffer from harm caused indirectly as a result of their capture. Animals that are hooked and fight the hook may over-exert themselves, exhausting muscle energy sources and causing a severe metabolic acidosis. These animals may appear normal may fight with great force when handled, but may not have the ability to recover if returned to the sea in an exhausted condition. The longer an animal fights, or the greater the intensity of the fight, the more likely it will have problems recovering from the hooking incident.

If an animal is hooked and is unable to surface, it will obviously drown within a relatively short period of time. The time will depend on the length of time since the animal last surfaced, the water temperature, the size of the turtles and the amount of struggling the animal does on the line.

Turtle interactions with hooks are traumatic incidents. Although some individuals may survive relatively unharmed, the vast majority will suffer significant injury and potential mortality as a result of being hooked.

If you have any further questions please contact me directly. I apologize that this response is tardy, but I was away when the package of information arrived.

Sincerely,

Joseph P. Flanagan DVM
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Robert A. Morris, MS, DVM
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November 24, 2000

Mr. Donald R. Knowles, Director
Office of Protected Resources
National Marine Fisheries Service
Silver Spring, MD 20910

Dear Mr. Knowles:

In response to your request on sea turtles and fishing gear, I offer the following observations as a contract veterinarian for sea turtles for the National Marine Fisheries in Honolulu.

1. Some hooks remain unchanged for months in the intestinal tract of turtles with no evidence of dissolving (followed with X-rays).
2. Turtles have been seen with ingested hooks and are apparently healthy. On the other hand, hooks that perforate the G.I. Tract can cause death.
3. Hooked turtles trailing monofilament line can cause serious problems with line wrapped around the flipper, resulting in tissue and bone necrosis. We have done numerous flipper amputations because of this problem. Ingestion of the monofilament line can also cause serious problems to the intestinal tract.

The most important aspect for the survival of hooked turtles is removal of the hook, and if that is not possible, cut the trailing line as short as possible. Any hooked turtle with trailing mono line is in serious trouble.

If you require additional information, let me know.

Sincerely,

Robert A. Morris, MS, DVM